

# PATENT SPECIFICATION

DRAWINGS ATTACHED

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## COMPLETE SPECIFICATION

### Improvements in or relating to Electric Conducting Liquid Switches

5 We, ENGEL & GIBBS LIMITED, a British Company, of Warwick Road, Boreham Wood, Elstree, Hertfordshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to electric conducting liquid switches for the making and/or breaking of electrical circuits.

15 The invention relates in particular to the so-called "mercury type" control switches in which an electrically conductive liquid such as mercury is contained in a sealed tube under vacuum or other desired conditions such as an inert gas. Two or more electrodes projecting into the tube are usually provided and the movement of the mercury or other electrically conductive liquid is used to control an electric circuit by the completing or breaking of electrical continuity between the electrodes.

20 It has previously been proposed to provide such a control switch with means providing a delayed make or delayed break, such means usually being in the form of a restricted passageway through which the mercury or other conducting liquid has to pass so that its flow is retarded. In most prior arrangements a restricted passageway has been formed by reducing the cross section of a portion of the tube but such an arrangement has a number of serious disadvantages, one of which is the difficulty of reducing the size of the passageway to provide a delay of considerable duration. If the cross sectional area of the passageway is reduced to give a long delay, difficulty occurs in getting the mercury or other conductive liquid to pass through the passageway satisfactorily and frequently

gas locks result with consequent damage to ancillary equipment owing to the subsequent failure of the control switch to operate. A further disadvantage of the known constructions is the difficulty of calibrating the switch, as the desired cross sectional area of the passageway cannot be accurately produced.

It is accordingly an object of the invention to provide an electric control switch of the kind specified in which the above disadvantages are overcome. A further object is to provide an improved electric control switch incorporating a delay device which can be manufactured easily and which can be accurately pretimed to suit individual delay requirements.

According to the invention there is provided a control switch comprising a sealed envelope, two or more electrodes projecting therein and an electrical conductive liquid in said envelope and movable to complete or break electrical continuity between the electrodes, wherein the movement of the electrical conductive liquid in the envelope is delayed by a thin metallic disc which is sealed completely around its edges into the envelope and is formed with a wetted aperture therein for the passage of the electrical conductive liquid therethrough.

The term "thin" as used above in relation to the disc or plate and hereinafter in the claims is intended to cover a thickness of less than 0.001 inches.

In the preferred embodiment of the invention this disc or plate is made of platinum and is preferably 0.0005 inches in thickness.

One embodiment of the invention will now be described by way of example with reference to the accompanying drawings, in which:—

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Figure 1 is a side view of the control switch of the make, delay break type showing the switch in its inoperative position;

Figure 2 is a side view of the same switch showing the switch in the make position;

Figure 3 is a section on the line III-III of Figure 1 with the mercury in the switch open condition; and

Figure 4 is an enlarged sectional view of the delay section of the switch with the mercury removed.

The preferred form of switch comprises a glass envelope 10 having a varying cross-section and provided with a pair of electrodes 11 and 12 which project into the envelope. The envelope is evacuated or otherwise filled with an inert gas and a predetermined quantity of mercury or other electrical conductive fluid is introduced into the envelope as shown by the cross-hatching in Figures 1, 2 and 3. The purpose of the switch is to make and break the electrical continuity between the electrodes 11 and 12 and this is done by tilting the switch about a transverse axis between the positions shown in Figures 1 and 2. In Figure 1 the circuit is broken and the switch is in its inoperative position, while in Figure 2 the switch has been tilted to its operative position and the circuit has been completed.

It has been usual to provide a switch of this type with means to provide a delay in the making or breaking of the circuit. In the embodiment shown a greatly improved and more efficient delay device is provided and will be described as providing a delayed break.

Referring now to Figure 3 it will be seen that the electrode 12 is sealed into a bulb-like extension 14 which projects from one side of the main section or compartment 13 of the envelope and communicates therewith through an aperture 15 in the envelope. The electrode 11 is located in an extension 17 of the compartment 13 and it will be appreciated that during operation both extensions will retain a certain quantity of mercury so that the electrodes act as mercury contacts with the main mass of mercury during its movement in the envelope.

A tube 20 is provided to permit the escape of mercury from the compartment 13 of the switch. In this tube there is positioned a restriction in the form of a thin disc 21 in which is formed a small accurately calibrated hole 22 (see Figure 4) to control the rate at which the mercury leaves the compartment 13 of the switch. The size of the hole 22 determines the length of time during which the circuit between the electrodes 11 and 12 remains made.

With the switch in the position of Figure 2, the circuit between the two electrodes will remain closed until the level of the mercury falls below the edge of the aperture 15 to

the bulb 14, when the circuit will be broken.

Referring now to Figure 4 the disc 21 is formed of a metal unaffected by contact with mercury such as platinum. The hole 22 is accurately calibrated during manufacture of the disc to give any required delay in the operation of the switch. During the manufacture of the disc, a globule of mercury is inserted into the hole 22 filling the hole and protruding therefrom on either side of the disc as shown at 23 and 24. This causes the disc to be permanently wetted and ensures that no priming is necessary to start the operation of the delay device. The disc is made from very thin metal sheet of less than 0.001 inches thick and preferably 0.0005 inches thick to enable it to be easily sealed into the glass tube and also to minimise the production of air or gas locks in the hole 22.

A second section or compartment 27 is provided in the switch and acts as an air bypass for the disc 21 to ensure the smooth flow of mercury. Compartment 27 is formed with an extension 28 extending into the compartment 13 of the switch to prevent mercury from flowing down the air passage.

The invention allows the accurate manufacture of control switches having delays of the order of one second to three minutes without difficulty.

It will, of course, be understood that the disc 21 may be used in other types of delay switch to give delayed making of contacts instead of delayed breaking or any combination of delayed making and breaking of circuits as may be desired.

#### WHAT WE CLAIM IS:—

1. A control switch comprising a sealed envelope two or more electrodes projecting therein and an electrical conductive liquid in said envelope and movable to complete or break electrical continuity between the electrodes, wherein the movement of the electrical conductive liquid in the envelope is delayed by a thin metallic disc which is sealed completely around its edges into the envelope and is formed with a wetted aperture therein for the passage of the electrical conductive liquid therethrough.

2. A control switch according to Claim 1, wherein the switch is provided to break the electrical continuity between two electrodes after a controlled delay.

3. A control switch according to either of Claims 1 or 2, wherein the electrodes are maintained in contact with conductive liquid during the whole of the operating sequence so that any making or breaking of the electric continuity between them is between bodies of the conductive liquid.

4. A control switch according to any preceding claim, wherein the conductive liquid is mercury.

5. A control switch according to any pre-

ceding claim, wherein the disc is formed of platinum.

6. A control switch substantially as described herein with reference to the accompanying drawing.

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## PROVISIONAL SPECIFICATION

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- The invention relates in particular to the so-called "mercury-type" control switches in which an electrically conductive liquid such as mercury is contained in a sealed tube under vacuum or other desired conditions such as an inert gas. Two or more electrodes projecting into the tube are usually provided and the movement of the mercury or other electrically conductive liquid is used to control an electric circuit by the completing or breaking of electrical continuity between the electrodes.

- It has previously been proposed to provide such a control switch with means providing a delayed make or delayed break, such means usually being in the form of a restricted passageway through which the mercury or other conducting liquid has to pass so that its flow is retarded. In most prior arrangements a restricted passageway has been formed by reducing the cross section of a portion of the tube but such an arrangement has a number of serious disadvantages, one of which is the difficulty of reducing the size of the passageway to provide a delay of considerable duration. If the cross sectional area of the passageway is reduced to give a long delay, difficulty occurs in getting the mercury or other conductive liquid to pass through the passageway satisfactorily and frequently gas locks result with consequent damage to ancillary equipment owing to the subsequent failure of the control switch to operate. A further disadvantage of the known constructions is the difficulty of calibrating the switch, as the desired cross sectional area of the passageway cannot be accurately produced.

- It is accordingly an object of the invention to provide an electric control switch of the kind specified in which the above disadvantages are overcome. A further object is to provide an improved electric control switch incorporating a delay device which can be manufactured easily and which can be accu-

rately pretimed to suit individual delay requirements.

According to the invention there is provided a control switch comprising a sealed envelope, two or more electrodes projecting therein and an electrical conductive liquid in said envelope and movable to complete or break electrical continuity between the electrodes, wherein the movement of the electrical conductive liquid in the envelope is delayed by means comprising a thin disc or plate provided in the envelope intermediate its ends and formed with an aperture therein for the passage of the electrical conductive liquid therethrough.

In the preferred embodiment of the invention the disc or plate is made of platinum and the envelope is made in two parts which are sealed together about the platinum disc or plate.

In order that the invention may be clearly understood the preferred embodiment will now be described. It will, however, be understood that this is given by way of example only and that various modifications may be made to suit individual requirements.

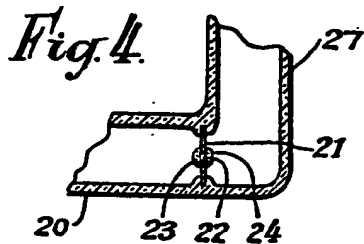
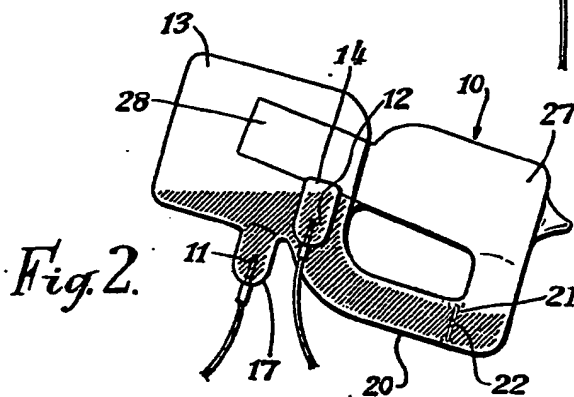
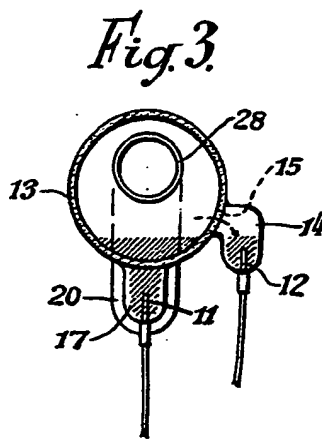
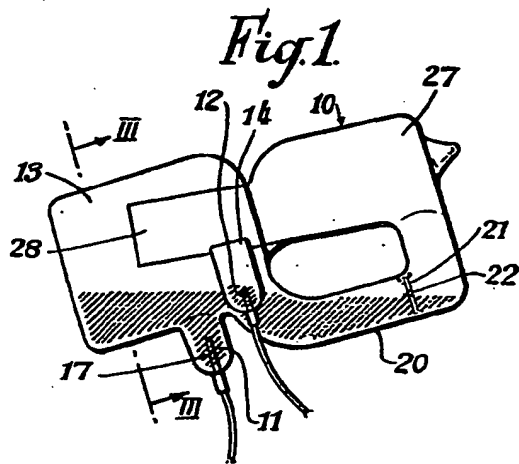
In the preferred embodiment the control switch comprises a glass tube which is formed in two parts which are subsequently sealed together in a manner to be hereinafter described. Each section of the glass envelope is provided in the usual manner with one or more electrodes depending upon the electrical circuits which are to be controlled by the switch. Prior to the assembly of the two sections of the envelope a quantity of mercury or other conductive liquid is inserted in the sections.

In order to provide the control switch with a delay or lag in operation, a restriction is formed in the envelope intermediate its ends so as to retard the movement of the mercury from one end of the envelope to the other during tilting movements of the switch. The restriction is provided by a thin disc of a metal which is substantially unaffected by contact with the mercury and a very suitable metal is platinum. The disc is manufactured as thin as possible and is, for example, of the order of 0.0005 inches thick and this disc is located between the two sections of the tube when they are sealed together.

Prior to assembly the disc is formed with

an aperture, the cross sectional area of which depends upon the time lag required for the switch. The area of the aperture can be accurately produced and therefore the switch  
5 can be calibrated to give the desired delay characteristic. It will be appreciated that the provision of such a disc does not present an edge to the mercury due to the thinness of the disc so that the two bodies of mercury  
10 are, in effect, able to meet through the aperture i.e. both sides of the disc are permanently wetted with the mercury, which greatly assists the movement of the mercury from one section to the other. The switch is, therefore, self-priming and the possibility of gas locks is substantially eliminated. The invention allows the accurate manufacture of control switches having delays of the order of one second to three minutes without difficulty.  
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